

Factor/Percentage Change questions

Worked Example

A ball-bearing has a diameter of 7.94mm and a mass of 2.04g. Calculate the mass of a 12.7mm ball bearing that is identical except for its size.

The larger ball-bearing is $\frac{12.7}{7.94} = 1.60$ times wider.

Diameter and mass are related by $m = \rho V = \rho \frac{4}{3} \pi \left(\frac{d}{2}\right)^3$ so $m \propto d^3$ if density is constant.

If the diameter is 1.60 times larger, the mass will therefore be $1.60^3 = 4.09$ times larger.

Mass of larger bearing = $2.04 \times 4.09 = 8.35\text{g}$.

- 1) Lacrosse and bowling balls have a similar density. A lax ball is 64mm in diameter, a bowling ball is 217mm. If a lacrosse ball has a mass of 148g, what would you expect a bowling ball's mass to be?
- 2) A resistor is connected to a 6V battery. The battery runs down slightly, and V drops to 5.7V. By what percentage does the Power developed in the resistor drop by¹?
- 3) A resistor is connected to a 6V supply. To increase the power developed in the resistor by 50%, what pd should the power supply be set to?
- 4) A wire extends when a Force is applied to it. To reduce the extension by four times (*i.e.* to make it extend only $\frac{1}{4}$ as much), how much thicker should the wire be if everything else about the wire must stay the same?

¹ In questions 2 and 3 you may assume the resistor obeys Ohm's Law but you may not assume the current stays constant.

- 5) A star at the end of its life accretes (gains) an extra 5% mass from a nearby object. By what percentage does its diameter increase by, if its average density remains the same?
- 6) One soap bubble has three times the diameter of another. How much extra soap solution is the larger bubble made from?
(assume the thickness of the bubble wall is much smaller than the diameter of the bubble)
- 7) Jupiter's diameter is about 9.7 times smaller than the Sun's. The Sun's mass is about 1050 times greater than Jupiter's, yet both objects have a similar composition (mainly Hydrogen and Helium).

Show that these data are approximately consistent.

Try to suggest a sensible reason why the data are only approximately consistent.